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Comparison of pregnancy outcomes between maternity waiting home users and non-users at hospitals with and without a maternity waiting home: retrospective cohort study

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Objective: To examine the impact of a maternity waiting home (MWH) by comparing pregnancy outcomes between users and non-users at hospitals with and without an MWH.

Methods: We conducted a retrospective cohort study in Ethiopia comparing one hospital with an MWH (Attat) to a second hospital without one (Butajira). A structured questionnaire among sampled women in 2014 and hospital records from 2011 to 2014 were used to compare sociodemographic characteristics and pregnancy outcomes between Attat MWH users and non-MWH users, Attat MWH users and Butajira, and Attat non-MWH users and Butajira. χ^2 or ORs with 95% CIs were calculated.

Results: Compared with Attat non-MWH users ($n=306$) and Butajira women ($n=153$), Attat MWH users ($n=244$) were more often multiparous (multipara vs primigravida: OR 4.43 [95% CI 2.94 to 6.68] and OR 3.58 [95% CI 2.24 to 5.73]), less educated (no schooling vs secondary school: OR 2.62 [95% CI 1.53 to 4.46] and OR 5.21 [95% CI 2.83 to 9.61], primary vs secondary school: OR 4.84 [95% CI 2.84 to 8.25] and OR 5.19 [95% CI 2.91 to 9.27]), poor (poor vs wealthy: OR 8.94 [95% CI 5.13 to 15.61] and OR 12.34 [95% CI 6.78 to 22.44] and further from the hospital (2 h 27 min vs 1 h 00 min and 1 h 12 min: OR 3.08 [95% CI 2.50 to 3.80] and OR 2.18 [95% CI 1.78 to 2.67]). Comparing hospital records of Attat MWH users ($n=2784$) with Attat non-users ($n=5423$) and Butajira women ($n=9472$), maternal deaths were 0 vs 20 (0.4%; $p=0.001$) and 31 (0.3%; $p=0.003$), stillbirths 38 (1.4%) vs 393 (7.2%) (OR 0.18 [95% CI 0.13 to 0.25]) and 717 (7.6%) (OR 0.17 [95% CI 0.12 to 0.24]) and uterine ruptures 2 (0.1%) vs 40 (1.1%) (OR 0.05 [95% CI 0.01 to 0.19]) and 122 (1.8%) (OR 0.04 [95% CI 0.01 to 0.16]). No significant differences were found regarding maternal deaths and stillbirths between Attat non-users and Butajira women.

Conclusions: Attat MWH users had less favourable sociodemographic characteristics but better birth outcomes than Attat non-users and Butajira women.

Keywords: Maternity waiting homes, Pregnancy outcome, High-risk pregnancy, Obstetrics, Maternal-Child Health Service, Maternal mortality, Perinatal mortality

Introduction

Most of the 303 000 maternal deaths, 2.6 million stillbirths and 2.7 million early neonatal deaths that are estimated to have

occurred in 2015 could have been prevented through timely access to skilled maternity care.^{1–3} Access is still a major challenge in many low- and middle-income countries (LMICs).⁴ A 2015 systematic review showed that less than one-third of

women with obstetric complications actually reached a facility that provided emergency obstetric and newborn care.⁵ Barriers to access are the lack of a nearby facility and transport, long travel times due to poor roads or traffic and economic and cultural factors.^{4,6,7}

In some LMICs, subsidized routine and emergency transport systems are available for women seeking obstetric care. The number of ambulances, for instance, is growing rapidly. Their impact, however, is still limited because fully functional transport systems require considerable additional investments as well as a high level of logistic coordination.⁴ Maternity waiting homes (MWHs) near health facilities, where women are encouraged to spend the final weeks of pregnancy, are a means to bypass resource-intensive transport requirements and provide ready access to the clinic as soon as labour starts or complications arise.⁸ MWHs are present in more than 25 countries, but the evidence that these homes actually improve maternal and neonatal outcome is limited.^{8,9} The World Health Organization has therefore stated that research on the effectiveness of MWHs needs to be prioritized.¹⁰ A Cochrane review on MWHs found no randomized controlled trials and only six observational studies that evaluated the effect of MWHs on maternal and perinatal outcome, of which four reported better outcomes among users compared with non-users.⁸ The main point of criticism of these studies is that delivery outcomes of MWH users were compared with non-MWH users within the same hospital. This may lead to selection bias, since the latter group of women were more likely to start labour at home and seek help only after developing complications. Their outcomes were often poor, which may produce an overestimation of the protective effect of MWHs.⁸

The rationale behind the present study is to improve on the population group comparisons by including a population of labouring women in a hospital without an MWH, which will contain women with high-risk pregnancies who might have used an MWH if the hospital had had one available. These women likely expressed different health-seeking behaviour compared with

women who only go to the hospital if complications arise. Hence, by bringing into the comparison a population of labouring women without access to an MWH, the aforementioned selection bias is reduced.

The objective of this study was to examine the impact of an MWH by comparing pregnancy outcomes between three groups of women who gave birth in Attat Hospital and Butajira Hospital: MWH users vs non-MWH users in Attat Hospital, MWH users in Attat Hospital vs Butajira Hospital and non-MWH users in Attat Hospital vs Butajira Hospital.

Materials and methods

Design and study area

Using a structured questionnaire, sociodemographic data were collected in 2014 among sampled MWH and non-MWH users who gave birth in Attat Hospital and among post-labour women in Butajira Hospital. Using a retrospective cohort design, data were abstracted from the routine hospital records of all women who gave birth at Attat Hospital and Butajira Hospital from January 2011 to December 2014.

Setting

This study took place in Ethiopia, where the maternal mortality rate decreased from 871 to 412 deaths per 100 000 live births between 2000 and 2016. In that same period, institutional births increased from 6% to 26%.¹¹ Attat and Butajira Hospitals were selected as study sites because these health facilities are similar in several regards, as summarized in Table 1. They are both located in the same zone: the Gurage Zone in the Southern Nations, Nationalities, and Peoples' Region, where 85% of the estimated 1.5 million people live in rural areas and 70 000 births are counted annually.^{12,13} The major difference between the two hospitals is that Attat Hospital had an MWH with 48 beds,

Table 1. Reasons for selecting study sites of Attat and Butajira Hospitals

Characteristic	Attat Hospital	Butajira Hospital
Location ¹²	<ul style="list-style-type: none">• Close to Welkite town (estimated population 52 223 inhabitants)• Western Gurage Zone• 175 km southwest of referral hospital in Addis Ababa	<ul style="list-style-type: none">• In Butajira town (estimated population 60 515 inhabitants)• Eastern Gurage Zone• 150 km south of referral hospital in Addis Ababa
Childbirth services ¹⁴	<ul style="list-style-type: none">• Comprehensive emergency obstetric and newborn care, 24 h/d, 7 d/wk• Family planning, antenatal and postnatal care services	<ul style="list-style-type: none">• Comprehensive emergency obstetric and newborn care, 24 h/d, 7 d/wk• Family planning, antenatal and postnatal care services
Labour ward staff ^{15,16}	1 obstetrician/gynaecologist, 1 surgeon, 1 anaesthetist, 4 health officers, 5 midwives	1 obstetrician/gynaecologist, 1 surgeon, 3 anaesthetists, 1 medical doctor, 1 health officer, 12 midwives
Labour ward beds	5	5
Average number of annual deliveries 2011–2014	2052	2368
Registration of deliveries	Registration book Ethiopian Federal Ministry of Health	Registration book Ethiopian Federal Ministry of Health

Table 2. Main reasons for admission to the MWH among a sample of MWH users at Attat Hospital (n=244)

Medical reason(s) for admission to the MWH	n (%)*
Obstetric history	
Previous caesarean section	76 (31.1)
Previous stillbirth/early neonatal loss	48 (19.7)
Current pregnancy	
Multiple pregnancy	36 (14.8)
Mal or breech presentation	25 (10.2)
Anaemia	20 (8.2)
Primigravida	19 (7.8)
Grand multiparity	17 (7.0)
Pre-eclampsia	16 (6.6)
Antepartum haemorrhage	13 (5.3)

*The percentages add up to more than 100% because some women had more than one reason for admission. MWH: maternity waiting home.

where 500–700 women stay annually, while Butajira Hospital did not have one at the time of the study.

The MWH at Attat Hospital was established in 1973. Admission criteria are based on risks relating to previous obstetric history, the current pregnancy or distance to a facility (see Table 2 for the most common reasons for admission among our sample of MWH users). MWH users stay 20 days on average and visit the antenatal clinic daily for check-ups and to participate in health education sessions on maternal health-related topics.¹⁷ They are asked to bring an attendant, usually their husband. Until the beginning of 2013, the user fee at Attat Hospital was 50 Ethiopian Birr (approximately \$2) for the MWH stay as well as the delivery. This fee was dropped following the introduction of a law on free delivery services. MWH users generally provide for their own transport, food and firewood; hospital meals are given to poor MWH users and their attendants.

Procedure

Sociodemographic data were collected using a structured questionnaire in the three aforementioned groups of women. For Attat Hospital, the sample size was calculated using Epi Info StatCalc, with a 5% margin of error and a 95% CI, based on the annual number of MWH users and non-MWH users who gave birth at Attat Hospital in 2012. In total, 244 MWH users and 306 non-MWH users (n=306) were sampled from the MWH and the post-labour ward, respectively. Data collection among MWH users took place between May and December 2014, and among non-MWH users in November and December 2014. In the post-labour ward of Butajira Hospital we were able to collect sociodemographic data from 153 women. Based on the annual number of births at Butajira Hospital in 2012, this sample has a margin of error of 7.5% at a CI of 95%. Women were sampled in the post-labour ward of Butajira Hospital between May and October 2014.

Hospital staff members were trained to collect the socio-demographic data. In the MWH of Attat Hospital and the post-labour ward of Butajira Hospital, data were collected using a larger questionnaire on MWHs for which data collectors received a 2-day training session that included study objectives, topics related to maternal health, interviewing skills, role-playing and test questionnaires. Data collectors in the post-labour ward of Attat Hospital received targeted training on how to conduct the one-page questionnaire. Data collectors were supervised by the investigators (GG and RS). The following variables were included: age category, parity, religion, literacy, education level, relative household wealth, travel time to the hospital of admission and, specifically for MWH users, reason(s) for admission to the MWH. Data collectors estimated the respondent’s age, since most women did not know their age. Parity was recorded and recoded into two categories: primigravida and multigravida. Respondents’ religion was recorded and recoded into ‘Christian’ or ‘Muslim’. To test literacy, respondents were asked to read a written sentence out loud. Respondents who could not read the entire sentence were categorized as non-literate. To determine their education level, respondents were asked to indicate the highest level of school they had attended. Respondents were asked to compare their household wealth with those around them on a four-point scale (very wealthy, wealthy, poor, very poor). In the analyses, a combined score was used: (very) wealthy and (very) poor. Furthermore, we asked how long it took respondents to travel from their household to the hospital of admission (in hours and minutes). Finally, reason(s) for admission to the MWH were registered using 13 predefined categories (previous caesarean section, previous stillbirth/early neonatal loss, multiple pregnancy, malpresentation, breech presentation, anaemia, primigravida, grand multiparity, pre-eclampsia, antepartum haemorrhage, polyhydramnion, previous fistula repair and other). Data were entered into SPSS version 22 (IBM, Armonk, NY, USA) by investigators FB and TV. Subsequently, data were double-checked variable by variable by TV.

The number of births, maternal deaths, uterine ruptures, live births, stillbirths and birth mode were abstracted from the hospitals’ monthly labour ward reports. Butajira Hospital registered uterine ruptures and assisted vaginal deliveries (vacuum extractions and forceps deliveries) from August 2012, thus these retrospective data are available from that month until December 2014.

Data analysis

Proportions were calculated for sociodemographic variables using the total number of respondents per sample. Because of some missing values, percentages will not always add up to 100%. Bivariate logistic regression was used to calculate crude ORs with 95% CIs comparing sociodemographic data of the three groups of women who gave birth in Attat and Butajira Hospitals.

In addition to reporting frequencies and proportions of pregnancy outcomes, the hospitals’ maternal mortality ratio and stillbirth rates were calculated. Furthermore, ORs with 95% CIs compared birth outcomes of the same three groups mentioned earlier. Since it was not possible to calculate the OR for maternal deaths (one of the values was zero), χ^2 was calculated for this outcome variable.

Table 3. Sociodemographic characteristics of selected samples of women who gave birth in Attat Hospital (MWH and non-MWH) and Butajira Hospital (N=703)

Variables and categories	Attat Hospital MWH (n=244), n (%)	Attat Hospital non-MWH (n=306), n (%)	Butajira Hospital (n=153), n (%)	OR (95% CI) Attat MWH vs non-MWH	OR (95% CI) Attat MWH vs Butajira	OR (95% CI) Attat non-MWH vs Butajira
Age in years						
≤24	63 (25.8)	99 (32.4)	43 (28.1)	1	1	1
25–34	152 (62.3)	191 (62.4)	91 (59.5)	1.25 (0.85–1.83)	1.14 (0.72–1.82)	0.91 (0.59–1.41)
≥35	27 (11.1)	16 (5.2)	17 (11.1)	2.65 (1.32–5.31)*	1.08 (0.53–2.23)	0.41 (0.19–0.88)*
Age in years—repeated						
25–34				1	1	1
≥35				2.12 (1.10–4.08)*	0.95 (0.49–1.84)	0.45 (0.22–0.93)*
Parity						
0 births	39 (16.0)	196 (35.6)	62 (40.5)	1	1	1
≥1 births	205 (84.0)	354 (64.4)	91 (59.5)	4.43 (2.94–6.68)*	3.58 (2.24–5.73)*	0.81 (0.55–1.20)
Religion						
Christian	117 (48.0)	269 (48.9)	61 (39.9)	1	1	1
Muslim	123 (50.4)	277 (50.4)	91 (59.5)	1.03 (0.74–1.45)	0.71 (0.47–1.06)	0.68 (0.46–1.01)
Literacy						
Literate	99 (40.6)	242 (44.0)	73 (47.7)	1	1	1
Non-literate	141 (57.8)	300 (54.6)	76 (49.7)	1.23 (0.87–1.73)	1.37 (0.91–2.06)	1.11 (0.75–1.65)
Educational level						
Secondary school and higher	23 (9.4)	117 (21.3)	54 (35.3)	1	1	1
Primary school	91 (37.3)	220 (40.1)	41 (26.8)	4.84 (2.84–8.25)*	5.19 (2.91–9.27)*	1.07 (0.67–1.72)
No schooling	126 (51.6)	209 (38.0)	57 (37.3)	2.62 (1.53–4.46)*	5.21 (2.83–9.61)*	1.99 (1.22–3.25)*
Educational level—repeated						
Primary school				1	1	1
No schooling				1.85 (1.27–2.70)*	1.00 (0.62–1.62)	0.54 (0.33–0.87)*
Relative household wealth						
(Very) wealthy	16 (6.6)	134 (24.4)	71 (46.4)	1	1	1
(Very) poor	228 (93.4)	416 (75.6)	82 (53.6)	8.94 (5.13–15.61)*	12.34 (6.78–22.44)*	1.38 (0.93–2.04)
Travel time to hospital (mean±SD)	2 h 27 min±1 h 27 min	1 h 00 min±52 min	1 h 12 min±1 h 7 min	3.08 (2.50–3.80)*	2.18 (1.78–2.67)*	0.81 (0.66–0.98)*

*p<0.05. MWH: maternity waiting home.

Results

Sociodemographic profile

Table 3 provides an overview of sociodemographic characteristics of MWH and non-MWH users in Attat Hospital and of women who gave birth in Butajira Hospital.

Comparing MWH users in Attat Hospital with non-MWH users in Attat Hospital and women in Butajira Hospital, MWH users were more likely to be ≥35 years of age than non-users, but no significant differences were found between users and women giving birth in Butajira Hospital. Furthermore, MWH users in Attat Hospital had higher odds of being multiparous, less educated and poorer than non-users in Attat Hospital and women in Butajira Hospital. They also travelled significantly longer to the hospital. No significant differences were found

regarding religion or literacy between users and non-users at the two hospitals.

Comparing non-MWH users in Attat Hospital with women giving birth in Butajira Hospital, non-users were less often ≥35 years of age, had more frequently attended primary school but less frequently attended secondary school or higher and their travel time was on average 12 min shorter. No significant differences were found regarding parity, religion, literacy and household wealth between non-users in Attat Hospital and women in Butajira Hospital.

Birth outcomes

In total, 17 679 births were attended to in Attat and Butajira Hospitals. No maternal deaths occurred in the MWH group in Attat Hospital, compared with 20 (0.4%) in the non-MWH group

in Attat Hospital ($p=0.001$) and 31 (0.3%) in Butajira Hospital ($p=0.003$). These data are equivalent to maternal mortality ratios of 0, 368.8 and 327.3 per 100 000 live births, respectively. No significant differences were found regarding maternal deaths between the non-MWH group in Attat Hospital and in Butajira Hospital (Table 4).

The number of stillbirths was significantly lower among MWH users (38 [1.4%]) than among non-MWH users (393 [7.2%]) and women in Butajira Hospital (717 [7.6%]). The corresponding stillbirth rates were 13.6, 72.5 and 75.7 per 1000 live births, respectively. No significant differences were found regarding stillbirths between the non-MWH group in Attat Hospital and in Butajira Hospital (Table 4).

Birth modes

MWH users had the highest proportion of caesarean sections (41.1%), compared with 22.0% among non-MWH users in Attat Hospital and 17.9% in Butajira Hospital (Table 4). Non-MWH users in Attat Hospital had the highest proportion of assisted vaginal deliveries (20.9%), compared with 13.5% among MWH users and 11.7% in Butajira Hospital.

Discussion

MWH users in Attat Hospital were less educated, poorer and had to travel longer to reach a hospital compared with both non-MWH users in Attat Hospital and women who gave birth in Butajira Hospital. While poverty and inequity are factors known to negatively impact the survival of women and neonates, the more vulnerable group of women in our study had better birth

outcomes than women with higher socio-economic status who did not use an MWH.^{18,19}

The sociodemographic characteristics of the three groups of women in this study were similar regarding religion and literacy. Overall, women who gave birth in Butajira Hospital were more educated, wealthier and lived closer to the hospital than women who gave birth in Attat Hospital; this may have been caused by sampling bias. Levels of education were higher among women in Butajira Hospital, which is located in town and serves more urban women, who generally have higher levels of education compared with women who live in rural areas.²⁰ In addition, user fees were higher for Butajira Hospital compared with Attat Hospital until the beginning of 2014, which may have negatively impacted service utilization.²¹ This may explain why women who gave birth in Butajira Hospital were wealthier on average. MWH women travelled an average of 2.5 h to Attat Hospital, while non-MWH users were on average only 1 h away. Women in Butajira Hospital travelled on average 12 min longer than non-users in Attat Hospital. This may be explained by the fact that Butajira Hospital did not have an MWH available that would have allowed for risk selection based on distance.

Between 2011 and 2014, all maternal deaths and nearly all stillbirths and uterine ruptures in Attat Hospital occurred among women who did not use the MWH. No data were collected to ascertain circumstances surrounding deaths. Our findings are consistent with the results from Kelly et al.²² covering the period 1987–2008 in the same hospital, although we found remarkably lower proportions of maternal deaths, uterine ruptures and stillbirths in the non-MWH group than the Kelly et al. study. Comparing the period 2011–2014 to 1987–2008, the hospital's maternal mortality ratio decreased by 72% and its stillbirth rate by 62%. These findings follow the Ethiopian trend with a 53% reduction in maternal mortality ratio in approximately the same period, which is likely the result of large investments in the

Table 4. Comparison of birth outcomes and birth mode of women in Butajira and Attat Hospitals (MWH and non-MWH) between 2011 and 2014 (n=17 679)

Variables	Attat Hospital MWH (n=2784), n (%)	Attat Hospital non-MWH (n=5423), n (%)	Butajira Hospital (n=9472), n (%)	OR (95% CI) Attat MWH vs non-MWH	OR (95% CI) Attat MWH vs Butajira	OR (95% CI) Attat non-MWH vs Butajira
Birth outcome						
Maternal deaths	0 (0.0)	20 (0.4)	31 (0.3)	— ^a	— ^b	1.13 (0.64–1.98)
Stillbirths	38 (1.4)	393 (7.2)	717 (7.6)	0.18 (0.13–0.25)*	0.17 (0.12–0.24)*	0.95 (0.84–1.08)
Uterine ruptures ^c	2 (0.1)	40 (1.1)	122 (1.8)	0.05 (0.01–0.19)*	0.04 (0.01–0.16)*	0.62 (0.43–0.88)*
Birth mode						
Assisted vaginal deliveries ^{c,d}	377 (13.5)	1133 (20.9)	799 (11.7)	0.46 (0.40–0.52)*	1.18 (1.04–1.35)*	2.14 (1.92–2.38)*
Caesarean section ^d	1145 (41.1)	722 (22.0)	1692 (17.9)	2.14 (1.92–2.38)*	3.21 (2.93–3.52)*	1.21 (1.12–1.32)*

MWH: maternity waiting home.

^a $\chi^2=10.292$ (df 1), $p=0.001$.

^b $\chi^2=9.135$ (df 1), $p=0.003$.

^cData available for 29 months only.

^dReference category for assisted vaginal deliveries = n – assisted vaginal deliveries.

^eReference category for caesarean sections = n – deliveries by caesarian section.

* $p<0.05$.

Ethiopian healthcare system.¹¹ Both our study and the Kelly et al. study found extremely large differences between MWH users and non-users in Attat Hospital. Other studies comparing MWH users with women admitted directly to the hospital reported smaller or even no differences.^{23–28} The findings from Attat Hospital could be the result of effective risk selection for MWH admission in Attat Hospital, in combination with the long-standing custom in Ethiopia of having a home delivery unless complications occur.²⁹

More caesarean sections were performed in Attat Hospital than in Butajira Hospital. The proportion of caesarean sections in the MWH group was especially high, indicating the high-risk status of the women admitted to the MWH. Similar findings were described by Kelly et al.²² in 2010. Moges et al.³⁰ reported that 90% of caesarean sections in Attat Hospital were performed as an emergency, with the following indications accounting for 83% of cases: cephalopelvic disproportion, previous caesarean section, foetal distress, malpresentation and malposition, and antepartum haemorrhage. Other studies comparing MWH users with women admitted directly to the hospital also reported higher proportions of caesarean sections in the MWH group, but the differences between the groups were smaller.^{24,27} The assisted vaginal delivery rate at both hospitals was comparable to those in high-income countries such as the UK and Canada.¹⁴ Vacuum extraction was more common in the non-MWH group compared with the MWH group. Kelly et al.²² indicated that this was due to the large number of women in the non-MWH group with an intra-uterine foetal death on arrival in the labour ward, which are mainly delivered by vacuum extraction. However, the stillbirth rate of Attat Hospital is comparable to that of Butajira Hospital, yet the latter had a much lower proportion of assisted vaginal deliveries. This may be due to differences between health providers in the way they manage childbirth. Another possible explanation is that some of the women in the non-MWH group who had an assisted vaginal delivery would have had an elective caesarean section if they had stayed at the MWH. Further research is needed to better understand the high vacuum extraction rate among non-users.

The MWH at Attat Hospital reached rural, poor, uneducated, high-risk pregnant women. This may be the result of an extensive community health promotion campaign that started in 1982. A study from Malawi reported similar findings, whereas a study from Timor-Leste concluded that the intervention only reached women within 5 km of the health facility.^{31,32} An important difference between the MWH in Timor-Leste and the one at Attat Hospital is the number of years that the MWH had been operational at the time of the study (1–3 y compared with 38 y, respectively).

This is the first observational study comparing pregnancy outcomes between MWH users and non-users at one hospital with a second hospital without an MWH. The study design clearly has its limitations. Firstly, data were abstracted from routine hospital records. Registers are often incomplete and under-reporting is a common problem in LMICs.^{1,33} No records were kept about high-risk pregnancies, preventing comparisons between high- and low-risk pregnancies. Secondly, the study design does not allow us to establish causality, only associations. A possible confounding effect could be the different ways that health providers at the two hospitals manage labour. Also,

health providers at Attat Hospital may have treated MWH users differently than non-users, with more attention and vigilance, and by encouraging MWH users to be proactive. Lastly, possible sampling bias may have caused sociodemographic differences, which means that our findings should be interpreted with caution. Nevertheless, since MWH users had significantly better outcomes than women who did not use an MWH, our data suggest that MWHs contribute to reducing maternal deaths, stillbirths and uterine ruptures, thereby providing an important service to women living in rural areas who have difficulty accessing facilities providing emergency obstetric and neonatal care.

Randomized controlled trials provide the highest level of scientific evidence but are ethically challenging in a setting with high barriers to accessing maternity care. Given these challenging circumstances, it would be worthwhile to further study the effectiveness of MWHs by comparing outcomes of both home and facility births in communities with an MWH to those in communities without an MWH.

Conclusions

High-risk pregnant women that used an MWH in rural Ethiopia had less favourable sociodemographic characteristics but better birth outcomes than women who gave birth at the same hospital but did not use the MWH and women who gave birth at a hospital without an MWH. The use of an MWH appears to improve birth outcomes by providing high-risk pregnant women with timely access to childbirth services and interventions in case they develop complications. This study provides additional evidence on the effectiveness of MWHs, which may guide policy-makers to further implement this intervention in Ethiopia and throughout the region.

Authors' contributions: FB, TV, GG and JS conceived and designed the study. FB, GG and RS led the data collection. Data analysis was done by all authors. FB and TV drafted the first manuscript, which was then edited by all the other authors. All authors read and approved the final manuscript.

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Competing interests: None declared.

Ethics approval and consent to participate: Ethical approval was obtained from the Southern Nations, Nationalities, and People's Regional State Health Bureau in Hawassa, Ethiopia, on 4 February 2014 (reference no. 1-1/9466). For the questionnaire, informed written consent was obtained from all respondents after explaining the purpose of the study, the importance of their contribution as well as their right to refuse participation. Illiterate women were asked to sign using their fingerprint.

The respondent's name was excluded from the questionnaire to ensure confidentiality.

Availability of data and material: The datasets used and analysed during the current study are available from the corresponding author upon request.

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